

Claims

[Claim 1]

A shell type needle roller bearing comprising a shell type outer ring formed by pressing a steel sheet and having a radially inner surface, and a plurality of needle rollers arranged along said radially inner surface of said outer ring, said steel sheet being formed of a medium to high carbon steel containing carbon by 0.3 mass percent or over.

[Claim 2]

The shell type needle roller bearing of claim 1 wherein said steel sheet is spheroidize-annealed.

[Claim 3]

The shell type needle roller bearing of claim 2 wherein after said spheroidize-annealing, the spheroidization rate of carbides in the steel sheet is 50 percent or over.

[Claim 4]

The shell type needle roller bearing of any of claims 1-3 wherein said outer ring is subjected to induction hardening or bright hardening after pressing.

[Claim 5]

The shell type needle roller bearing of any of claims 1-3 wherein said steel sheet contains an alloy element of at least one of Si, Ni and Mo by not more than 0.35 mass percent.

[Claim 6]

The shell type needle roller bearing of claim 5 wherein at least the radially inner surface of said outer ring is subjected to induction hardening and then tempering in a furnace or induction tempering after pressing so that the radially inner surface of said outer ring has a Vickers hardness of

653 HV or over.

[Claim 7]

The shell type needle roller bearing of claim 5 or 6, wherein the hardened portion formed by the induction hardening applied to the radially inner surface of said outer ring is of such a depth that said hardened portion stops short of the radially outer periphery of said outer ring.

[Claim 8]

The shell type needle roller bearing of any of claims 1-7 wherein the radially inner surface of said outer ring has a circumferential roughness average RA in the range of between 0.05 and 0.3 micrometers.

[Claim 9]

The shell type needle roller bearing of any of claims 1-8 wherein the radially inner surface of said outer ring has an axial roughness average RA not exceeding 0.3 micrometers.

[Claim 10]

The shell type needle roller bearing of any of claims 1-9 wherein said steel sheet is formed into said outer ring by drawing the steel sheet up to three times, and in the final drawing step, the steel sheet is ironed, too.

[Claim 11]

The shell type needle roller bearing of claim 10 wherein said steel sheet is formed into said outer ring by drawing the steel sheet once, and the steel sheet is ironed simultaneously when the steel sheet is drawn.

[Claim 12]

The shell type needle roller bearing of any of claims 1-11 wherein said steel sheet is coated with phosphate.

[Claim 13]

A support structure for supporting a spindle for rotating

compression elements, said support structure comprising a needle roller bearing supporting said spindle in the compressor, and said spindle, wherein said needle roller bearing is the shell type needle roller bearing of any of claims 1-12.

[Claims 14]

The support structure of claim 13 wherein said compressor is an air compressor including a swash plate.

[Claim 15]

A support structure for supporting a piston pump driver portion, said support structure comprising a motor output shaft of the piston pump, a needle roller bearing mounted on an eccentric portion of said motor output shaft, and a piston supported by said needle roller bearing, wherein said needle roller bearing is the shell type needle roller bearing of any of claims 1-12.

[Claim 16]

The support structure of claim 15 wherein said piston pump is used in a vehicle anti-lock brake system.